THE CENTER FOR FOOD SAFETY

Public Citizen 30 YEARS
Protecting Health, Safety & Democracy

December 18, 2002

Livestock and Seed Programs
Agricultural Marketing Service
U.S. Department of Agriculture
Stop 0249, Room 2092-S
Washington, DC 20250-0249
Fax: (202) 720-3499

Re: Public Comment on 2002 Farm Bill Food Safety Technologies Provision

Dear Sir or Madam:

On behalf of Public Citizen and the Center for Food Safety, two non-profit consumer organizations, we would like to comment on the United States Department of Agriculture's efforts to implement the provisions of Section 4201 (b) (3) of the Farm Security and Rural Investment Act of 2002 (Farm Bill) – "Use of Approved Food Safety Technologies."

Flawed Process

We would like to state, at the outset, that the comment period on this issue and the notice for it are not sufficient. We make this observation for a number of reasons.

- The November 22, 2002 press release issued by the USDA press office did not specifically mention a deadline for submission of comments. It was only after we contacted the USDA press office that we learned of the thirty-day comment period that is due to expire on December 22, 2002 (that falls on a Sunday). Consequently, we do not believe that the public was properly notified of this comment period;
- The comment period falls during the holiday season when most people's attention is focused elsewhere;
- The Managers' Statement that accompanied this section of the Farm Bill stated: "The Managers expect the Secretary to continue to make commodity purchases, taking into consideration the acceptability by recipients of products purchased and considering the relative costs of products available for purchase."[1] A thirty-day comment period is not sufficient to gauge consumer acceptance or rejection of controversial technologies such as

[1] Joint Explanatory Statement of the Committee of Conference, Farm Security and Rural Investment Act of 2002, p. 110

irradiation, which your press release specifically cites as one of the technologies you will approve;

- It is our understanding that the contracting specifications for the commodity purchases made for the various nutrition programs USDA administers normally are released during the spring of each year. Consequently, we do not understand why there is a December 22 deadline for comments on this very important issue. Therefore, we strongly urge you to extend the comment period until at least March 31, 2003;
- Even more troubling is the fact that the decision seems to have been already made by the Department even before the comment period has closed. In a December 12, 2002 Reuters story, a USDA official is quoted as saying that the Department intends to permit irradiated products to be served in the National School Lunch Program.[2]

Farm Security and Rural Investment Act of 2002

Section 4201 (b) (3) of the Farm Bill states the following:

> USE OF APPROVED FOOD SAFETY TECHNOLOGY.—
> (1) IN GENERAL.—In acquiring commodities for distribution through a program specified in paragraph (2), the Secretary shall not prohibit the use of any technology to improve food safety that—
> (A) has been approved by the Secretary; or
> (B) has been approved or is otherwise allowed by the Secretary of Health and Human Services.
> (2) PROGRAMS.—A program referred to in paragraph (1) is a program authorized under—
> (A) this Act;
> (B) the Food Stamp Act of 1977 (7 U.S.C. 2011 et seq.);
> (C) the Emergency Food Assistance Act of 1983 (7 U.S.C. 7501 et seq.);
> D) the Richard B. Russell National School Lunch Act (42 U.S.C. 1751 et seq.); or
> (E) the Child Nutrition Act of 1966 (42 U.S.C. 1771 et seq.).[3]

In addition to those programs specifically listed in the legislation, participants in the Food Distribution Program on Indian Reservations and the Commodity Supplemental Food Program will also be affected by this provision. These six programs provide economic and nutritional assistance to the most indigent and vulnerable in our society.

It is obvious from the November 22 press release that it is the intention of the Department to remove the prohibition against commodities that have been treated with irradiation to be purchased for the various nutrition programs that USDA administers. The Department went out of its way to endorse irradiation as a method to implement this section of the Farm Bill. The press release stated:

---

[2] Randy Fabi, "Parents Protest U.S. Schools Irradiated Meat Plan," Reuters, http://biz.yahoo.com/rc/021212/food_schools_1.html.

[3] Farm Security and Rural Investment Act of 2002.

"For example, the use of irradiation for raw meat and poultry products was approved in 1999 after the Food and Drug Administration (FDA) determined that it was a safe measure in helping reduce food borne pathogens. Food irradiation is recognized by the World Health Organization as one of the most effective food decontamination methods available for meat and poultry products."[4]

It has been a longstanding policy of the United States Department of Agriculture to prohibit the purchase of commodities that have been treated with irradiation for the various nutrition programs it administers. For example, the most current "Technical Data Supplement (TDS) for the Procurement of Frozen Ground Beef Items, TDS-136 -- June 2000, Modified – 2002" contains the following statement:

"Irradiation of raw materials or finished products will not be allowed as an intervention step."[5]

For the National School Lunch Program alone, the USDA purchased 142,050,000 pounds of frozen beef products during the 2001-2002 School Year.[6] According to FY 2002 data provided by the Food and Nutrition Service (FNS), the decision to remove the irradiation prohibition will affect millions of Americans:

National School Lunch Program: 27,909,346 (participants)[7]

Food Stamp Program: 19,110,045[8]

Other Child Nutrition Act programs

- National School Breakfast Program: 8,124,889[9]
- Child and Adult Care Food Program: 2,812,691[10]
- Summer Food Service Program: 1,884,749[11]
- After School Snacks Program (snacks served): 122,000,000[12]

Emergency Food Assistance Program (pounds distributed): 611,000,000[13]

---

[4] United States Department of Agriculture press release, "USDA REQUESTS INPUT REGARDING FARM BILL REQUIREMENT ON APPROVED FOOD SAFETY TECHNOLOGIES FOR USE IN COMMODITY PURCHASE PROGRAMS," November 22, 2002.

[5] United States Department of Agriculture, Agricultural Marketing Service, Livestock and Seed Program, "Technical Data Supplement (TDS) for the Procurement of Frozen Ground Beef Items, TDS-136 – June 2000, Modified – June 2002, p.2.

[6] United States Department of Agriculture, Agricultural Marketing Service, Livestock and Seed Program, http://www.ams.usda.gov/lsg/cp/beef/BEEF%20Vendor%20state%20Tables%20SY01-02.pdf.

[7] United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/slfypart.htm.

[8] United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/fsfypart.htm.

[9] United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/sbfypart.htm.

[10] United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/ccfypart.htm.

[11] United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/sffypart.htm.

[12] United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/annual.htm.

Food Distribution Program on Indian Reservations: 110,000 (participants)[14]

Commodity Supplemental Food Program: 427,300 (participants)[15]

Removing the prohibition will turn these programs into the largest distribution of irradiated food products ever undertaken in the world. It will also turn millions of Americans, particularly children, into unwitting laboratory experiments to determine whether this technology, whose chemical by-products are still being studied for their potential harmful effects, is really safe. What makes this decision even more reprehensible is the fact that the most vulnerable in our society will not have a choice in the matter, nor will they have to be informed that they are consuming foods that have been treated with a controversial and potentially unsafe technology because current regulations do not require meals prepared with irradiated foods to carry identifying labels.

Public Perception of Irradiation/Labeling

There have been a number of studies done on consumer attitudes toward irradiated food and the labeling required for it. While some conducted by industry have been showing increased support for irradiation, there is still significant opposition to consuming foods treated with this technology. One notable group that seems consistently to have serious reservations about food irradiation are women who have children living at home.

At the March 2002 Intertech Annual Conference on Food Irradiation, Dr. Sean Fox, Agricultural Economics Professor at Kansas State University, reported that based on his research, women who have children living at home were the most opposed to food irradiation.[16]

Furthermore, this particular demographic group is the most likely to support labeling for irradiated foods. In a national poll conducted for Public Citizen in January 2002, over four-fifths (83%) of women who had children living at home favored labeling for foods that had been irradiated. This compared with 73% of all persons surveyed who favored food irradiation labeling.[17] This supported findings from a 1999 national poll conducted for the Center for Science in the Public Interest and the American Association of Retired Persons in which 92.9% of female respondents favored labeling for irradiated foods as opposed to 84.0% for male respondents.[18]

---

[13] Ibid.
[14] United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/pd/fdpart.htm.
[15] Ibid.
[16] MeatNews.com, "Marketing Irradiated Meat," March 29, 2002 http://www.meatnews.com/index.cfm?fuseaction=article&artNum=2968.
[17] "Public Citizen: Questions on Irradiated Food and Inspection of Meat-Processing Plants – Banners from an Omnibus Survey of 1000 Nationwide Registered Voters." Lake, Snell, Perry & Associates, Inc., January 13 – 15, 2002.
[18] "Food Irradiation." national public opinion survey of 1000 persons over the age of 18 years conducted for Center for Science in the Public Interest and the American Association of Retired Persons by Buskin-Golding Research, April 16-18, 1999.

Since most of the nutrition programs targeted in Section 4201(b)(3) of the Farm Bill benefit children, it is likely that USDA will suffer a significant backlash from parents should the prohibition on irradiation be lifted from the commodities purchased for these programs. The Managers of the Farm Bill recognized this possibility, so the Agricultural Marketing Service should tread carefully and deliberately on this issue. The rushed nature of the public comment period does not indicate that the agency is doing this.

It should also be noted that the U.S. Food and Drug Administration conducted six focus groups during the Summer of 2001 (they were held in Calverton, Maryland; Minneapolis, Minnesota; and Sacramento, California) in which consumers were specifically asked their opinions on labeling for irradiated foods. In its report to Congress on this issue, the FDA stated:

> "Everyone agreed that irradiated foods should be labeled honestly."[19]

Even after being given more information about the irradiation process, a typical consumer comment during one of the Minneapolis focus group sessions was:

> "I'm very hesitant to buy anything that's irradiated. I want to make sure that it's labeled clearly and that I have a choice. And, given that choice, with what I know now, I would choose not to."[20]

Research on Harmful Effects of Consuming Irradiated Foods

Another aspect of recipient acceptance that USDA must consider is the safety and wholesomeness of irradiation as a food additive. Serious concerns are outlined in the attached Affidavit, incorporated herein by reference, of William W. Au, Ph.D., an expert toxicologist consulting with Public Citizen and the Center for Food Safety. As shown in his attached C.V., Dr. Au is a Professor in the Department of Preventive Medicine and Community Health, University of Texas Medical Branch, in Galveston. His affidavit details the scientific case against providing irradiated foods to vulnerable school children.

In essence, he indicates that it would be plainly arbitrary and capricious for USDA to approve irradiated food aimed at what he describes as a "physically and economically vulnerable" population. He also states that obtaining informed consent from students and parents to accept the risks of irradiated school food is not practically feasible.

Dr. Au's affidavit refers to a study of human children eating a freshly-irradiated diet, published in 1975 in the *American Journal of Clinical Nutrition*.[21] It is the **only** controlled, published irradiation study focused on children, albeit in India. As it specifically examined effects on

---

[19] U.S. Food and Drug Administration, "Congressional Report on Irradiation Food Labeling: House Rept. 107-116; H.R. 2330 and Conference Action P.L. 107-76," June 2002, p.5.

[20] "Consumers' Understanding of Food Irradiation Labeling: Focus Group Report." submitted to Food and Drug Administration, Center for Food Safety and Applied Nutrition, ORC Macro, April 2002, p. 8.

[21] The results of this study were supported, and criticisms against it rebutted, by the researchers in two later detailed defenses, which the USDA also should consider. Vijayalaxmi and S.G. Srikantia, 1989, "A review of the studies on the wholesomeness of irradiated wheat, conducted at the National Institute of Nutrition, India." *Radiation Phys. Chem.* 34:941-952; and Vijayalaxmi, 1999, "Comparison of studies on the wholesomeness of irradiated wheat: A review." *Nutrition Research* 19:1113-1120.

malnourished children, who are the high-priority recipients of USDA's commodity program food, USDA should consider the study as persuasive. Dr. Au states:

> *In one study, malnourished children who were fed freshly irradiated wheat had more chromosome aberrations than those who were fed non-irradiated or stored irradiated wheat (Bhaskaram and Sadasivan, 1975).... There may be subpopulations such as undernourished children who are most susceptible to toxic effects of irradiated food. Strong reasons exist for considering children generally to be especially susceptible to toxic materials (Au 2002). Undernourished schoolchildren in the United States are the population segment most likely to consume a high percentage of their daily food intake from the school meal programs (breakfast, snack, and lunch), as their parents have fewer alternative choices due to economic reasons.*
>
> *Effects that have significant public health implications such as polyploidy, genetic alterations, and tumor promotion are critically important not to ignore when children are involved, especially when those children may be undernourished and have few practical alternatives, therefore are physically and economically vulnerable. The wisdom and fairness of compelled exposure to these effects should be considered seriously and explicitly by USDA with respect to the pending proposal for school food irradiation. Irradiating the food to be eaten by millions of growing children would expose them to toxicity hazards for which it would very difficult, if not impossible, to obtain truly informed consent from them or their parents.*

Dr. Au refers to his separate journal-published article that addressed special vulnerabilities of children.[22] He comments in that article that profound differences can exist between children and adults as far as exposure to toxic substances. Chemical exposures during childhood could increase health problems such as cancer later in life. This concern is supported by the reported increases in rates of brain cancer in children and of testicular cancer in young adults. He states that regulatory policies generally are still not adequate to protect children.

The reasons for the different vulnerabilities of children and adults are fairly straightforward. Children are more active than adults. As a result, they drink more water, breathe more air and eat more food per pound of body weight compared to adults. Thus, they are proportionally exposed to more toxic chemicals from the environment and from materials they ingest than adults, making them susceptible to toxicants.

Children of course undergo tremendous developmental changes compared to adults. These changes involve complex and integrated activities that lead to differentiation, organogenesis, morphogenesis, rapid and controlled cell division, and developmental stage-specific gene activities. All of these processes can be negatively affected by toxic substances.

Dr. Au's affidavit also highlights the new European information on alkylcyclobutanones. This line of research emerged into view in the English-speaking world only after 1999, when FDA

---

[22] Au, W.W. 2002, "Susceptibility of children to environmental toxic substances." *Int. J. Hygiene and Environ. Health* 205: 501-503.

and USDA approved the sale of irradiated ground beef. Indeed, FDA and USDA have never publicly addressed this new toxicity information. Yet, these European studies, from a well-respected source, establish that substances **unique** to irradiated foods are **cytotoxic**, **genotoxic**, and **promote colon tumor formation** in rats.

Two types of alkylcyclobutanones – 2-dodecylcyclobutanone and 2-tetradecylcyclobutanone – have been detected in beef irradiated at 1 kiloGray, far below the maximum allowable dose for beef of 4.5 kiloGray. The concentrations of these chemicals were shown to increase linearly as irradiation doses increased.[23] Additionally, cooking has been shown to reduce the amounts of 2-dodecylcyclobutanone, but "there is no difficulty in detecting it in cooked, irradiated samples."[24]

The Au affidavit also documents that at least seven peer-reviewed and long published reports found mutagenic effects of irradiated diets fed to mammals. Further, many other experts have called for, at least, more research on food irradiation's safety.[25] Notably, 26 medical experts and many other prominent individuals endorsed a detailed warning in a health journal on the dangers of food irradiation generally.[26] The list of endorsers is impressive.[27]

The European alkylcyclobutanone researchers, the most prominent scientists actively working in this area now, "suggest that caution should be exercised before any risk to consumers by exposure to these compounds is denied."[28] USDA must likewise exercise caution and must neither deny nor ignore the unresolved questions until the risk issues are settled. If USDA approves the use of irradiated food in school nutrition programs – a decision to intentionally expose students to potentially toxic materials – it would expose the agency to serious scandal, particularly as the new toxicity information from Europe that is now in press is published.

Economically advantaged students would still be able to avoid irradiated food by bringing their own food from home. But, poor students will not be able to avoid it. Anyone who believes "consumer acceptance" for such unequal exposure to a controversial technology will happen without controversy is deluded. Protests and possible litigation will result and will detract from public support for USDA. The health impact and fairness controversies will not go away and they will undercut the faith of students and their parents in long-trusted USDA commodity

---

[23] Stevenson, M.H. "Identification of irradiated foods." *Food Technology*, 48:141-144, 1994.

[24] Crone, A.V.J. et al. "Effect of storage and cooking on the dose response of 2-dodecylcyclobutanone, a potential marker for irradiated chicken." *Journal of the Science of Food and Agriculture*, 58:249-252, 1992. Cited in Stevenson, M.H. "Identification of irradiated foods." *Food Technology*, 48:141-144, 1994.

[25] See, Louria, D.B. 1993. Food irradiation: Perceptions of a qualified opponent. *Infectious Diseases in Clinical Practice* 2:313-316; Tritsch, G.L. 2000. Food irradiation. *Nutrition* 16:698-701; Steinberg, J., quoted in R. Papazian 1992. Food irradiation - A hot issue, *Harvard Health Letter,* vol. 17, no. 10, p. 3.

[26] Epstein, S.S., and W. Hauter. 2001. Preventing pathogenic food poisoning: Sanitation not irradiation, *Intl. J. of Health Services* 31:187-192.

[27] Some examples of prominent MD and Ph.D. endorsers of the warning: Neal Barnard, President, Physicians Committee for Responsible Medicine; Donald Dahlsten, Professor and Associate Dean, Univ. of California, Berkeley; Robert Elder, Senior Microbiologist, Neogen Co.; Samuel Epstein, Emeritus Professor of Environmental Medicine, Univ. of Illinois School of Public Health, and Chairman of the Cancer Prevention Coalition; Jay M. Gould, Director, Radiation and Public Health Project; William Lijinsky, past Director of Chemical Carcinogenesis, Frederick Cancer Research Center; Donald Louria, Chairman, Department of Preventive Medicine, New Jersey Medical School; Vincente Navarro, Professor, The Johns Hopkins Univ. and Univ. of Pompeu Fabra, Spain; and Dr. Quentin Young, past President, American Public Health Association.

[28] D. Burnouf, H. Delincée, A. Hartwig, E. Marchioni, M. Miesch, F. Raul, D. Werner. "Comment on a statement of the SCF [EU Scientific Committee on Food] on a report on 2-alkylcyclobutanones." Unpublished report, Sept. 19, 2002.

programs. These amount to additional consumer acceptance and indirect cost factors that USDA must take into account in its decision-making.

Increased Costs of Commodities

Irradiation will add costs to the commodities purchased under the programs enumerated in Section 4201 (b) (3) of the Farm Bill. As the Managers of the legislation anticipated, the treatment of commodities with most, if not all, of the "approved food safety technologies" will engender additional costs to the programs for which they will be procured. For products treated with irradiation, consumers currently pay between $.02 cents per pound[29] to as much as $.20 per pound[30] more than non-irradiated food. If these additional costs were applied to the frozen beef purchases made during the 2001-2002 school year, they would have raised the program costs for the National School Lunch Program between $4,065,800 and $40,658,000. Unless there are additional appropriations from the Congress to cover these additional costs, commodity purchases may have to be curtailed to implement this provision of the Farm Bill.

Administrative Concerns

Some irradiation proponents have proposed that irradiated meat purchased for the National School Lunch Program be segregated from non-irradiated meat to allow school districts to opt-out from using irradiated meat should they wish to do so.[31] How will USDA be able to ensure that such segregation takes place? The controversy surrounding the failure to segregate genetically modified StarLink corn from the human food supply makes such a suggestion seem impractical.

In addition, parents have already expressed an interest in being informed when irradiated food products are being served in the National School Lunch Program.[32] We agree that parents should be notified. Should a notification requirement be adopted, whose responsibility will that be? Will it be USDA's? Will it be the school district's? Will there be additional costs incurred for such notification? Who will be responsible for those costs?

Potential Conflict of Interest

The Food and Nutrition Service of the USDA administers all of the nutrition programs enumerated in Section 4201 (b) (3) of the Farm Bill. Most of these fall under the jurisdiction of the Special Nutrition Program of the Food and Nutrition Service. The current deputy FNS Administrator for this program is Dr. Peter S. Murano. Dr. Murano is currently on-leave from

---

[29] United States Food and Drug Administration, "Food Irradiation: A Safe Measure," http://www.fda.gov/opacom/catalog/irradbro.html.

[30] Patricia Callahan, "Supermarkets Test Appetite for Irradiated Meat," reprinted from *Wall Street Journal* in *Minnesota Star-Tribune*, November 28, 2002, http://www.startribune.com/stories/1556/3450026.html.

[31] Randy Fabi, "Parents Protest U.S. Schools Irradiated Meat Plan," Reuters, http://biz.yahoo.com/rc/021212/food_schools_1.html.

[32] Ibid.

his teaching position at Texas A & M University and is a well-known food irradiation advocate.[33]

Not too long prior to his appointment to his current position at FNS, the SureBeam Corporation, a leading food irradiation company in the United States, entered into a strategic alliance with Texas A & M University.[34] Texas A & M signed a 10-year research and development deal with SureBeam. SureBeam provided the school with millions of dollars worth of irradiation equipment – which Texas A&M employees operate at low costs or for free – and SureBeam enjoys the economic benefits. The company has stated that this arrangement is worth more than $10 million. In March 2002, a research facility was dedicated at Texas A & M in which SureBeam's electron-beam irradiation technology will be used.[35]

SureBeam has been actively signing contracts with food processing firms across the country, and it is very likely that one or more of these firms will be bidding on contracts to supply the programs that Dr. Murano is now administering with commodities treated with irradiation.

Incidentally, Dr. Peter Murano is the spouse of the USDA Under Secretary for Food Safety, Dr. Elsa Murano, another well-known advocate for food irradiation.[36] Prior to her current position, she served as the Director for the Center for Food Safety at Texas A & M University. We strongly urge that a firewall be established to prevent her involvement in this process.

Conclusion

While we welcome this opportunity to comment on this very important issue, we do not believe that there was proper notice given to the millions of Americans who will be affected by a potential policy change by the USDA. The request for comments needs to be better publicized and more time needs to be allotted to solicit input from the public. In addition, for this process to be meaningful, the Department needs to evaluate all of the comments before moving forward.

Irradiation is not a cure-all for food safety problems in schools. In the last year, several prominent media outlets have exposed a range of problems that can make school food unsafe, ranging from appalling conditions in crumbling school cafeterias, to budget cuts that force administrators to cook food across town from where it is served. There is much that should be done to improve the safety of food served to our nation's schoolchildren, but irradiation will not get us any closer to that goal.

Finally, and most important, for the health reasons cited above, we believe that the ban on the use of irradiation to treat commodities purchased for the various nutrition programs USDA administers ought to be continued. USDA should increase its inspection resources to ensure that the food processed in meat and poultry facilities is safe and wholesome. Irradiation is not the

---

[33] see http://www.tamu.edu/foodscience/fresearch.htm

[34] Titan Corporation, "Titan Corporation and Texas A & M University System Enter into Strategic Alliance," press release, June 15, 2000 (the Titan Corporation was the former parent of SureBeam).

[35] SureBeam Corporation, "Texas A & M Dedicates Nation's First SureBeam Research Facility," press release, March 4, 2002.

[36] "Food Irradiation Considered Safe," press release, Texas A & M University, May 16, 2000, http://agnews.tamu.edu/stories/NUTR/May1600a.htm.

answer to poor sanitation or improper slaughtering and processing practices in meat and poultry plants. As a consumer during one of the FDA focus groups on food irradiation labeling stated:

> "I'd rather see the food-butchering process and packing cleaned up, rather than to kind of keep that dirty and then zap it afterwards."[37]

Should you have any questions, please feel free to contact us.

Sincerely,

Wenonah Hauter, Director
Public Citizen's Critical Mass
Energy and Environment Program
215 Pennsylvania Avenue SE
Washington, DC 20003
(202) 454-5150

Andrew Kimbrell, Director
Center for Food Safety
660 Pennsylvania Avenue SE
Washington, DC 20003

(202) 547-9359

Attachment

[37] ORC Macro, op. cit., p. 9.

Expert Affidavit on Safety Issues of Irradiated Food for School Children

By: William W. Au, Ph.D.
Date: December 10, 2002.

William Au, being duly sworn, hereby deposes and says:

A. My address is: Division of Environmental Toxicology, Department of Preventive Medicine and Community Health, Ewing Hall, 700 Harborside Drive, University of Texas Medical Branch, Galveston, Texas 77555-1110, where I have been employed as a Professor since 1991. My Curriculum Vitae is attached hereto indicating my professional qualifications as a toxicologist. My primary research interest is in conducting molecular and cellular studies to elucidate toxicological mechanisms for the induction of human disease. Since obtaining my Ph.D. from the University of Cincinnati, I have more than 20 years of experience teaching, conducting and publishing peer-reviewed research, consulting and speaking internationally, editing professional publications, and serving on numerous expert committees. I am a member of the major scientific societies related to toxicology and have received approximately one dozen awards recognizing my professional contributions. I have delivered more than 35 invited lectures internationally and published or co-published more than 200 articles in the toxicology field.

B. I submit this Affidavit to the United States Department of Agriculture with respect to its public comment period on food safety technologies for use in its commodity purchase programs pursuant to the recent Farm Bill, specifically on the agency's consideration of allowing the use of ionizing radiation on food served to school children.

C. I submit this Affidavit on behalf of two Washington, DC, non-profit groups, the Center for Food Safety and Public Citizen, who have retained me as a consulting expert. Prior to this consultation I had no prior involvement with those or any other non-profit groups involved in food irradiation issues.

D. In formulating my opinion, I have reviewed relevant documents and studies and conducted independent research.

E. My opinion, based on a reasonable degree of scientific certainty, is as follows:

1) The use of radiation to decontaminate/sterilize foods destined for human consumption should be evaluated for health concerns very carefully. Radiolytic products are formed during the irradiation of food (Schubert, 1969). Their potential health hazards have not been adequately evaluated. More research is needed on the products that are unique to the irradiation process. A recently-discovered unique class of radiolytic products that are generated from the irradiation of fat-containing food is 2-alkylcyclobutanone (2-ACB) with saturated and mono-unsaturated alkyl side chain: 2-decyl-, 2-dodecyl-, 2-dodecenyl-, 2-tetradecyl- and 2-tetradecenyl-cyclobutanone (Miesch et al., 2002).

2) Since 1998, concern regarding health hazards from the consumption of irradiated food has been focused on the toxicity of 2-ACB. Using in vitro assays, 2-ACB has been shown to be genotoxic and mutagenic (Delincee and Pool-Zobel, 1998; Delincee et al., 1998; Burnouf et al., 2001; Delincee et al., 2002). 2-ACB has also been tested in experimental animals. In one report (Horvatovich et al., 2002), laboratory rats were fed a very low concentration of 2-ACB in drinking water, and the absorption and excretion of the chemical were monitored. The study showed that less than 1% of the administered chemical was excreted in feces. A portion of the chemical crossed the intestinal barrier, entered the blood stream and accumulated in the adipose tissues of the animal. It follows that consumption of irradiated food for a long time can cause accumulation of toxic 2-ACB in the adipose tissues of human consumers, including school children.

3) The recent findings by Raul et al. (2002) raised a high level of concern. Although the detail of the study is not available yet, the summary of the report indicates that 2-ACB is a promoter for colon cancer in rats. A promoting agent does not usually cause cancer by itself but alters cellular functions (Zheng et al., 2002; Yamagata et al., 2002). The unique concern with promoters is that they can significantly enhance the carcinogenic effects of known carcinogens (Hecker et al., 1982; Slaga, 1984; Langenbach et al., 1988). Experimental animals that are treated with both promoters and carcinogens develop tumors much earlier and have more tumor nodules than animals treated with the carcinogens alone. Animals treated with the promoters alone would not develop tumors more often than the untreated animals.

4) Colon cancer (as was discovered in the rat study on 2-ACBs) is a serious health problem in humans, causing approximately 60,000 deaths per year in the United States. Consumption of improper diet is a major cause for colon cancer: foods that are high in fat especially from animal sources, meat cooked with high heat, charred meat, and food with high content of aromatic/heterocyclic amines (Colon cancer folder in the American Cancer Society website – www.cancer.org; Lang et al., 1986; Vineis and McMichael, 1996). Therefore, consumption of the improper diet together with food that contains 2-ACB which acts as a tumor promoter can increase the risk for the development of colon cancer. Under this scenario, individuals who would normally outlive the risk for colon cancer might develop the cancer. As there has not been a systematic investigation in the population, this cancer promotion concern remains unaddressed.

5) Numerous other peer-reviewed published reports have long indicated the mutagenic activities of irradiated foods fed to mammals (Anderson et al., 1980; Bugyaki et al, 1968; Maier et al., 1993; Moutschen-Dahmen, et al., 1970; Vijayalaxmi, 1975, 1976, 1978; Vijayalaxmi and Rao, 1976; Vijayalaxmi and Sadasivan, 1975). The health concerns from consumption of irradiated food simply cannot be considered to have been resolved (Louria, 2001).

6) Only two published studies have been conducted to investigate mutagenicity hazards in people who consumed freshly irradiated food. In one study, malnourished children who were fed freshly irradiated wheat had more chromosome aberrations than those who were

fed non-irradiated or stored irradiated wheat (Bhaskaram and Sadasivan, 1975). In the other study, healthy adults were fed irradiated food for three months and no increased chromosome aberrations were observed (Institute of Radiation Medicine, 1987). However, upon reanalysis of the data, an increase in chromosome aberrations with borderline statistical significance was reported (Louria, 1990). The data indicate that consumption of irradiated food can cause genotoxic effects and therefore health hazards in the population. More importantly, there may be subpopulations such as undernourished children who are most susceptible to toxic effects of irradiated food. Strong reasons exist for considering children generally to be especially susceptible to toxic materials (Au 2002). Undernourished schoolchildren in the United States are the population segment most likely to consume a high percentage of their daily food intake from the school meal programs (breakfast, snack, and lunch), as their parents have fewer alternative choices due to economic reasons.

7) Effects that have significant public health implications such as polyploidy, genetic alterations, and tumor promotion are critically important not to ignore when children are involved, especially when those children may be undernourished and have few practical alternatives, therefore are physically and economically vulnerable. Furthermore, exposing human beings to hazardous substances at an early age will increase the likelihood that the induced health effects will be manifested within their life spans. The wisdom and fairness of compelled exposure to these effects should be considered seriously and explicitly by USDA with respect to the pending proposal for school food irradiation. Irradiating the food to be eaten by millions of growing children would expose them to toxicity hazards for which it would very difficult, if not impossible, to obtain truly informed consent from them or their parents.

Dated this 12 day of December 2002, at Friendswood, Texas.

Signature

State of Texas

:ss.

County of Harris

Subscribed and sworn to before me this 12th day of December, 2002.

Pamela J. DeLeon

Notary Public

PAMELA J. DELEON
Notary Public State of Texas
My Commission Expires
6/27/04

C.V. attached

References

Anderson, D., Clapp, M.J.L., Hodge, M.C.E., Weight, T.M. Irradiated laboratory animal diets – dominant lethal studies in the mouse. Mutat. Res. 80, 333-345, 1981.

Au, W.W. Susceptibility of children to environmental toxic substances. Int. J. Hygiene and Environ. Health 205, 501-503, 2002.

Bhaskaram, C., Sadasivan, G. Effects of feeding irradiated wheat to malnourished children. Am. J. Clin. Nutri. 28:130-135,1975.

Bugyaki, L., Deschreider, A.R., Moutschen, J., Moutschen-Dahmen, M., Thijs, A., Lafontaine, A. Do irradiated foodstuffs have a radiomimetic effect? II. Trials with mice fed wheat meal irradiated at 5 Mrad. Atompraxis 14:112-118, 1968.

Burnouf, D., Delincee, H., Hartwig, A., Marchioni, E., Miesch, M., Raul, F., Werner, D. Etude toxicologique transfrontaliere destinee a evaluer le risqué encouru lors de la consommation d'aliments gras ionises / Toxikologische Untersuchung zur Risikoberwertung beim Verzehr von bestrahlten fetthaltigen Lebensmitteln – Eine franzosisch-deutsche Studie im Grenzraum Oberrhein. Rapport final / Schlussbericht Interreg II. Projet / Projekt No 3.171, 2001.

Delincee, H., Pool-Zobel, B.L. Genotoxic properties of 2-dodecylcyclobutanone, a compound formed on irradiation of food containing fat. Radiat. Phy. Chem. 52:39-42,1998.

Delincee, H., Pool-Zobel, B.L., Rechkemmer, G. Genotoxicity of 2-dodecylcyclobutanone. Food Irradiation: Fifth German Conference, Report EFE-R-99-01, Federal Nutrition Research Institute, Karlsruhe, Germany, 1998.

Delincee, H., Soika, C., Horvatovich, P., Rechkemmer, G., Marchioni, E. Genotoxicity of 2-alkylcyclobutanones, markers for an irradiation treatment in fat-containing food – Part I: cyto- and genotoxic potential of 2-tetradecylcyclobutanone. Radiat. Phys. Chem. 63, 431-435, 2002.

Hecker, E. Cocarcinogenesis and Biological Effects of Tumor Promoters. Raven Press, NY, 1982.

Horvatovich, P., Raul, A.F., Miesch, M., Burnouf, C.D., Delincee, D.H., Hartwig, E.A., Werner, F.D., Marchioni, E. Detection of 2-alkylcyclobutanones, markers for irradiated foods, in adipose tissues of animals fed with these substances. J. Food Prot. 65, 1610-1613, 2002.

Institute of Radiation Medicine. Safety evaluation of 35 kinds of irradiated human foods. Chin. Med. J. 100, 715-718, 2000.

Lang, N.P., Chu, D.Z., Hunter, C.F., Kendall, D.C., Flammang, T.J., Kadlubar, F.F. Role of aromatic amine acetyltransferase in human colorectal cancer. Arch. Surg. 121, 1259-1261, 1986.

Louria, D.B. Zapping the food supply. Bull. Atomic Sci. 46, 34-36, 1990.

Louria, D.B. Food irradiation: unresolved issues. Clin. Infect. Dis. 33, 378-380, 2001.

Langenbach, R., Elmore, E., Barrett, J.C. Tumor Promoters: Biological Approaches for Mechanistic Studies and Assay Systems. Raven Press, NY, 1988.

Maier, P., Wenk-Siefer, I., Schawalder, H.P., Zehnder, H., Schlatters, J. Cell-cycle and ploidy analysis in bone marrow and liver cells of rats after long-term consumption of irradiated wheat. Fd. Chem. Toxic. 31:395-405, 1993.

Miesch, M., Miesch, L., Horvatovich, P., Burnouf, D., Delincee, H., Hartwig, A., Raul, F., Werner, D., Marchioni, E. Efficient reaction pathway for the synthesis of saturated and mono-unsaturated 2-alkylcyclobutanones. Radiat. Phy. Chem. 65, 233-239, 2002.

Moutschen-Dahmen, M., Moutschen, J., Ehrenberg, L. Pre-implantation death of mouse eggs caused by irradiated food. Internat. J. Rad. Biol. 18: 201-216, 1970.

Raul, F., Gosse, F., Delincee, H., Hartwig, A., Marchioni E., Miesch, M., Werner, D., Burnouf, D. Food-borne radiolytic compounds promote experimental colon carcinogenesis, Nutr. Cancer, in press, 2002.

Schubert, J. Mutagenicity and cytotoxicity of irradiated foods and food components. Bull. World Hlth. Org. 41:873-904,1969.

Slaga, T.J. Mechanisms of Tumor Promotion. CRC Press, Boca Raton, Fla., 1984.

Vijayalaxmi. Cytogenetic studies in rats fed irradiated wheat. Int. J. Radiat. Biol. 7:283-285,1975.

Vijayalaxmi. Genetic effects of feeding irradiated wheat to mice. Canad. J. Genet. Cyto. 18:231-238,1976.

Vijayalaxmi. Cytogenetic studies in monkeys fed irradiated wheat. Toxicology 9:181-184,1978.

Vijayalaxmi and Sadasivan, G. Chromosome aberrations in rats fed irradiated wheat. Int. J. Radiat. Biol. 27:135-142,1975.

Vijayalaxmi and Rao, K.V. Dominant lethal mutations in rats fed on irradiated wheat. Int. J. Radiat. Biol. 29:93-98,1976.

Vineis, P., McMichael, A. Interplay between heterocyclic amines in cooked meat and metabolic phenotype in the etiology of colon cancer. Cancer Causes Control 7, 479-486, 1996.

Yamagata, T., Yamagata, Y., Nishimoto, T., Nakanishi, M., Nakanishi, H., Minakata, Y., Mune, M., Yakawa, S. The impact of phorbol ester on the regulation of amiloride-sensitive epithelial sodium channel in alveolar type II epithelial cells. Exp. Lung Res. 28, 543-562, 2002.

Zheng, X., Ravatn, R., Lin, Y., Shih, W.C., Rabson, A., Strair, R., Huberman, E., Conney A., Chin K.V. Gene expression of TPA induced differentiation in HL-60 cells by DNA microarray analysis. Nucl. Acid Res. 30, 4489-4499, 2002.

CURRICULUM VITAE

NAME: William Wingkam Au, Ph.D. DATE: December, 2002.

PRESENT POSITION AND ADDRESS:

Professor
Division of Environmental Toxicology
Department of Preventive Medicine and Community Health
2.102 Ewing Hall
700 Harborside Drive
The University of Texas Medical Branch
Galveston, Texas 77555-1110
USA

Office Phone: 409/772-1545; 772-1803
Telefax: 409/772-9108
E-mail: william.au@utmb.edu

Director
International Science Outreach Program
Sealy Center for Environmental Health and Medicine
University of Texas Medical Branch

Director
International Collaboration Program
Sealy Center for Molecular Science
University of Texas Medical Branch

Editor
International Journal of Hygiene and Environmental Health

Chairman
Alexander Hollaender Fund for International Programs

BIOGRAPHICAL:

Date of Birth: October 30, 1946

Place of Birth: Hong Kong

Citizenship: United States of America

Marital Status: Married, one child

EDUCATION:

1972	Biology	B.A.	University of North Carolina Greensboro, North Carolina
1977	Developmental Biology	Ph.D.	University of Cincinnati Cincinnati, Ohio

PROFESSIONAL AND TEACHING EXPERIENCE:

1991-present	Professor	Division of Environmental Toxicology, Department of Preventive Medicine and Community Health, Univeristy of Texas Medical Branch, Galveston, TX
1988-present	Graduate Faculty	Human Genetics and Cell Biology Program, Graduate School of Biomedical Sciences, UTMB, Galveston, TX
1985-1990	Associate Professor	Division of Environmental Toxicology, Department of Preventive Medicine and Community Health, UTMB, Galveston, TX
1985-present	Graduate Faculty	Preventive Medicine Medicine and Community Health Program, Graduate School of Biomedical Sciences, UTMB, Galveston, TX
1984-1985	Assistant Professor	Division of Environmental Toxicology, Department of Preventive Medicine and Community Health, UTMB, Galveston, TX

1980-1984	Staff Scientist	Biology Division, Oak Ridge National Laboratory, Oak Ridge, TN
1979-1980	Research Associate	Department of Cell Biology, The University of Texas System Cancer Center, M.D. Anderson Hospital and Tumor Institute, Houston, TX
1977-1979	Post-doctoral fellow	Department of Biology, The University of Texas System Cancer Center, M.D. Anderson Hospital and Tumor Institute, Houston, TX

RESEARCH ACTIVITIES AND FUNDING HISTORY:

Dr. William Au's research interest is in conducting molecular and cellular studies to elucidate toxicological mechanisms for the induction of human disease. The working hypothesis is that individuals who have inherited variant metabolic and DNA repair gene alleles are susceptible to the induction of chromosome aberrations/gene mutations and thus have increased health risk from exposure to toxicants. Cancer patients are used as a model to document which susceptible versions of polymorphic genes are significantly associated with the disease. Cigarette smokers and workers with occupational exposure to toxicants are studied to demonstrate the toxicological mechanisms in support of the association. Besides using human volunteers, experimental animal and cells in culture are also used to conduct mechanistic studies under well-controlled exposure conditions. Molecular techniques and cytogenetic assays (e.g. FISH) are used for the investigations. These studies provide data for understanding the etiology of disease, the toxicological mechanisms for development of disease, and the application of the knowledge to risk assessment and disease prevention.

COMMITTEE RESPONSIBILITIES:

1. International

Project officer for U.S.-Egyptian Cytogenetic Program, 1985 - 1987.
Organizer - Participation of US scientists to present papers at the Second Southeast Asian Workshop on Short-Term Assays to Detect Environmental Mutagens, Carcinogens and Teratogens. Bankok, Thailand, Feb. 6-17, 1989.
Co-Chairman: First International Conference on Environmental Mutagenesis on Human Populations at Risk, Cairo, Egypt, January 20-25, 1992.
Co-Chairman: International Conference on Exposure to Carcinogens and Mutagens in the Industrial and Ambient Environment. Jerusalem, Israel, January 29-30, 1992.
Member-Organizing and Scientific Committee, Satellite Meeting of the International Union of Toxicology, Bologna, Italy, June 4-6, 1992.
Member-Advisory Board of Latin American Environmental Mutagen Society,

1990-present
Member-International Advisory Board Pan African Environmental Mutagen Society, 1992-present
Co-Chairman: Second International Conference on Environmental Mutagens in Human Populations, Prague, Czech Republic, August, 1995.
Co-Chairman: Third International Conference on Environmental Mutagens in Human Populations, Bangkok, Thailand, December, 1998.
Councilor: International Association of Environmental Mutagen Societies, August, 1997 - July, 2001.
Member-Program Committee: 8th International Conference on Environmental Mutagens, Shizuoka, Japan, October 21 - 26, 2001
Chairman - 4th International Conference on Environmental Mutagens in Human Populations, Brazil, 2003.
Scientific Advisor to Professor Dr. Her Royal Highness Princess Chulabhorn - organization of the Princess Chulabhorn Science Congress V, Bangkok, Thailand, 2004.
Chairman - International Advisory Board for the International Conference on Environmental Mutagens, San Franscisco, September, 2005.

2. National

Consultant for Food and Drug Administration (1981-present)
Gene-Tox Committee Member of the Environmental Protection Agency (1979-1980)
Member - Membership Committee of Environmental Mutagen Society (1987-1988)
Member - Program Planning Committee of Southwest Environmental Mutagen Society (1987-1988)
Member - Awards and Honors Committee of the Environmental Mutagen Society (1988-1989)
Member - Advisory Panel for the Texas Air Control Board (1989-1994)
Member - Peer Review Panel for Assessment of Radon Research Program for Department of Energy (1990)
Member - Peer Review Panel on DNA Repair and Genetics for Department of Energy (1990; 1991)
Member - Sub-committee on Anesthetic and Life Support Drugs, Food and Drug Administration (1990)
Member - Peer Review Panel for Medical Research and Development Command, United States Army (1993-present)
Organizer - Expert Panel on the Use of Genetic Monitoring for Risk Assessment in Communities Exposed to Hazardous Chemicals. US EPA, February 7-8, 1994.
Member - Peer Review Panel for National Institute of Environmental Health Sciences (1995 - present)
Member - Environmental Mutagen Society Diversity Committee (1995 - 1998).
Member - Program Planning Committee of the Environmental Mutagen Society (1996).
Member - Environmental Health Sciences Panel, National Institutes of Health, (1997 to

2001).
Chairman - Alexander Hollaender Fund for International Programs, (1997 to present).
Councilor - U.S. Environmental Mutagen Society (1999- 2003).
Member – Board of Scientific Counselors, Agency for Toxic Substances and Disease Registry (May, 1999 – April, 2005).
Chairman – Community and Tribal Subcommittee, Board of Scientific Counselors, Agency for Toxic Substances and Disease Registry (May, 2000 – present).

3. University

Member - University Curriculum Committee (1989-1991)
Member - University Chemical Safety Committee (1990-1994)
Member - Curriculum Committee, NIEHS - Toxicology Training Program (1994-1999)
Member - Seminar Committee, NIEHS - Toxicology Training Program (1994-1999)
Member - Internal Advisory Committee - Center for Environmental Toxicology (1997-8)
Member – Committee in Support of Science Education (1997 – present).
Presentation Judge – Undergraduate Research symposium (1996 – present).
Member - Radiation Safety Committee (1998-2001).
Member - Radioactive Drug Safety Committee (1998 - 2001)
Member - Chancellor's councilor, The University of Texas System (1995 to present).
Member – Admissions Committee, School of Medicine (1999 – 2002).
Chairman – Credential Committee, Graduate Program of the Department of Biological Chemistry and Genetics (2000 to present)
Member - Recruitment Committee, Graduate Program of the Department of Biological Chemistry and Genetics (2000 to 2001)
Member – Curriculum Committee, Graduate School of Biomedical Sciences (2000 – present)
Member – Curriculum Committee, BBSC, Graduate School of Biomedical Sciences (2001 - present)

4. Departmental

Chairman - Budget Committee - Graduate school program of the Department of Preventive Medicine and Community Health (1986-1987)
Member, Long-Range Planning Committee for the Department of Preventive Medicine and Community Health (1987-present)
Member, PMCH Residency Planning Committee (1987-1988)
Member, Steering Committee for departmental review. (1989-1990)
Member, Appointment, Promotion and Tenure Committee (1990-1993)
Member, Admissions Committee, Department of Human Biological Chemistry and Genetics (1991-1994)
Member, Seminar Committee, Department of Preventive Medicine and Community

Health (1994-present)
Member and then Chairman - Advisory Committee, Graduate Prograam for Department of Human Biological Chemistry and Genetics (1994-1997)
Member - Long Range Planning Committee, Cell Biology Graduate Program (1997-2001)
Member – Credential Committee, Graduate Program for Dapartment of Human Biological Chemistry and Genetics (2000 – present).
Member – Admission and Recruitment Committee, Cell Biology Graduate Program (1999 – 2001).
Member – Graduate Policy Committee, Preventive Medicine and Community Health (1999 - present).
Member – MPH course review committee, Preventive Medicine and Community Health (1999 – present)
Member – Comprehensive Examination Committee for Ph.D. candidacy, Preventive Medicine and Community Health (2001)

TEACHING RESPONSIBILITIES AT UTMB:

Chairman - Dissertation Committee for Kanokporn Rithidech (1984-1987)
Chairman - Dissertation Committee for Hasnaa Shafik (1984-1987)
Member - Dissertation Committee for Glen Talaska (1984-1987)
Chairman - Dissertation Committee for Mary Lowery (1984-1987)
Chairman - Dissertation Committee for Renate MacLaren (1984-1988)
Member - Dissertation Committee for Pamela Harris of The University of Texas Health Science Center in Houston (1987-1989)
Chairman - Dissertation Committee for Elie Hanania (1989-1992)
Member - Dissertation Committee for Zhidong Xu (1989-1992)
Chairman - Dissertation Committee for Treetip Chiewchanwit (1993-1996)
Chairman - Dissertation Committee for Lance Hallberg (1992-1997)
Chairman - Dissertation Committee for Randa El-Zein (1992-1998)
Course Director - Cytogenetics HGCB 6221, 1987-88.
Lecturer - Somatic Cell Genetics HGCB 6222, 1987-88.
Lecturer - Cell-Gene Course for the Medical School (1987-1992)
Lecturer - Preventive Medicine and Community Health for Medical School. (1990-1999)
Lecturer - Genetic Toxicology, PMCH 6325 (1987-1998)
Supervisor - Research project of a medical student, Miss Georgina Loya, 1992-1993
Lecturer - Principles of Drug Action (1994- 1998).
Lecturer - Cell Biology (1995- 1998).
Lecturer - Experimental Design (1995 - 1998).
Director - Environmental Health and Toxicology course for Preventive Medicine Residents and Graduate Students (1996-present)
Lecturer - Issues in Preventive Medicine (1998 - 1998).
Lecturer – Oncogene course (1999 – 1998).

Lecturer – Environmental and Genetic Toxicology, for 4th year medical students, School of Medicine (1999 to present).
Moderator – Practice of Medicine, School of Medicine (1999 – 2001)
Lecturer – Practice of Medicine, School of Medicine (1999 – 2001)
Lecturer – Cell Biology basic science course, Graduate School of Biomedical Sciences (1999 – 2000)
Lecturer – Gene, Evironment and Disease course, Graduate School of Biomedical Sciences (2000 - present)
Tutor – Interactive Learning Track, School of Medicine (2000 to present)
Training – Advanced Facilitator Training Workshop, 2000.
Director – Research Design Course in Environmental Toxicology, Graduate School of Biomedical Sciences (2002 – present)

AS MENTOR TO DOCTORAL STUDENTS

Marilyn Aardema (1986)
Kanokpoon Rithidech (1987)
Hasnaa Shafik (1987)
Mary Lowery (1987)
Renate MacLaren (1988)
Elie Hanania (1992)
Treetip Chiewchanwit (1995)
Lance Hallberg (1997)
Randa El Zein (1998)
Marc McConnell (1999)
Hernan Sierra-Torres (1997 - 2001)
Nohelia Cajas (1997 - 2001)
Salama Salama (1998 - 2001)

ADVISORY ACTIVITIES TO OTHER STUDENTS:

Sasaly AbuBakar, (1991 – 1995, Ph.D.)
Dennis Sawyer, (1997 – 1999, Ph.D.)
Jeff Hill (1998 - present)
Jeff Jones, M.D., (1998 – 1999, M.S.)
Robert Cox (1997 - present)
Marc Madsen (1999 - 2000)
Philip Kovoor, medical student (2000)
Barbara Bowerstock, medical student (2000)
Boris Oberheitman, Germany (1998 – 2000)

VISITING SCIENTISTS/POST-DOCTORAL FELLOWS:

Dr. Wagida Anwar - Fogarty International Fellow, Ain Shams University, Cairo, Egypt (May 1987-April 1988; August 1990-October, 1990)

Dr. Sawsan El-Ghazali - Peace Fellow, Ain Shams University, Cairo, Egypt (September 1989-January 1990).

Dr. Moon-Young Heo - University Fellow, Kangweon National University, Chuncheon, Korea (December 1989-November 1990).

Dr.. Randa El Zein - Alexandria University, Alexandria, Egypt (January 1990-December 1990).

Professor Luz Stella Hoyos - University of Antioquia, Colombia, South America (September, 1990-August, 1991)

Dr. Csilla Kormos, National Research Institute for Radiobiology and Radiohygiene, Budapest, Hungary (November, 1990-October, 1991)

Dr. Hongbao Ma, Tianjin Medical College, Tianjin, P.R. China (January, 1991-December 1992).

Dr. Shende Li, Chinese Academy of Medical Sciences, Beijing, P.R. China (April, 1991-July, 1992)

Dr. Shimin Cao, Chinese Academy of Medical Sciences, Beijing, P.R. China (March 1992-September, 1992).

Dr. Fatma Mohammed, Ain Shams University, Egypt (October, 1994- September, 1995)

Dr. Nivea Conforti Froes, University of San Paolo, Brazil (July, 1995-June, 1996)

Lecturer Mila Serrana, Miriam College Foundation, Manila, The Philippines (May, 1997 - April, 1998).

Lecturer Suparp Kietthebthew, Prince of Songkla University, Songkla, Thailand, October 1 - November 10, 1997.

Dr. Hyeong Oh, Director, Division of Genetic Toxicology, National Institute of Toxicological Research, Korean Food and Drug Administration, Seoul, Korea, December 26, 1998 - March 12, 1999.

Lecturer Suparp Kietthubthew, Prince of Songkla University, Songkla, Thailand, March 20 - June 10, 1999.

Professor Moon Heo, Kwangeon National University, Korea, December 20, 1999 to January 27, 2001.

Dr. Concepcion Arrastia, Clinical Fellow, Department of Obstetrics and Gynecology, The University of Texas Medical Branch, Galveston, Texas, March, 2000 to 2001.

Dr. Osama Badary, Department of Pharmacology and Toxicology, Al-Azhar University, Nasr City, Cairo, Egypt, July 1 – December 10, 2000.

Dr. Boris Oberheitmann, University of Bremen, Bremen, Germany, April 1 – 30, 2001.

Dr. Salama A. Salama, Department of Pharmacology and Toxicology, Al-Azhar University, Nasr City, Cairo, Egypt, October 1, 2001 – February 28, 2003.

Dr. Carsten Harms, University of Bremen, Bremen, Germany, November 15, 2001 – February 28, 2002.

MEMBERSHIPS IN SCIENTIFIC SOCIETIES:

American Association for the Advancement of Science (1985- present)

Environmental Mutagen Society (1979-present)
Sigma Xi (1981-present)
Southwest Environmental Mutagen Society (1986-present)
Society for Risk Analysis (1990-present)

CONSULTATION

Corporate consultant - Molecular Epidemiology; Simultec, Meilen/Zurich, Switzerland.

AWARDS AND HONORS:

1. International Cancer Research Technology Transfer Fellowship (1986) from the International Union Against Cancer

2. Visiting Professor, University of Bologna, Italy (1987)

3. Visiting Professor, Ain Shams University, Cairo, Egypt (1988-1991).

4. Chairman - First International Conference on Environmental Mutagenesis on Human Populations at Risk. Cairo, Egypt, January 20-25, 1992.

5. Chairman: International Conference on Exposure to Carcinogens and Mutagens in the Industrial and Ambient Environment. Jerusalem, Israel, January 29-30, 1992.

6. Chairman: Second International Conference on Environmental Mutagens on Human Populations, Prague, Czech Republic, August, 1995.

7. Symposium organizer: Genetic Susceptibility. Symposium for the US Environmental Mutagen Society, Minneapolis, Minnesota, April, 1997.

8. Chairman: Third International Conference on Environmental Toxicants on Human Populations. Bankok, Thailand, December, 1998.

9. Distinguished lecturer: Presented by the Commissioner, Korean Food and Drug Adminsitration, Seoul, Korea, June 16, 1999.

10. Recognition for Significant Contribution to the NATO (North Atlantic Treaty Organization) Conference, Turkey, September 23 - October 3, 1999, from the Director of the NATO Advanced Study Institute.

11. Award from the Environmental Mutagen Society for outstanding international education, research and services, in the Annual Conference, New Orleans, Louisiana, April, 2000.

12: Award from the University of Hong Kong as the Keynote Speaker in the 7th International Cancer Congress, 7 - 9 December, 2000.

13: Keynote speaker: NATO Advanced Research Workshop on Human Monitoring for Genetic Effects, Krakow, Poland, June 23-27, 2002.

EDITORIAL BOARD:

Member: Mutation Research (1990-present)
Member: Toxicology and Industrial Health, An International Journal (1990-present)
Associate Editor: Environmental Epidemiology and Toxicology (1998 to 2000)
Editor: International Journal of Hygiene and Environmental Health (2001 - present)

ADDITIONAL INFORMATION:

Reviewer for Human Genetics
Reviewer for Mutation Research
Reviewer for Environmental and Molecular Mutagenesis
Reviewer for Radiation Research
Reviewer for Toxicology and Industrial Health
Reviewer for Environmental Health Perspectives
Co-Editor for Environmental Health Perspectives, vol. 103, supplement 3, 1993.
Co-Editor for Environmental Environmental Health Perspectives, 1996.
Co-Editor for Mutation Research, 1999.

INVITED LECTURES AND WORKSHOP PRESENTATIONS (Selected Since 1991):

1. Seminar Speaker, Prediction of Potential Health Risks Using Short Term Cytogenetic Assays, The Upjohn Company, Kalamazoo, Michigan, January 21, 1991.

2. Symposium Speaker, Population Monitoring in First Latin American Workshop on Mutagenesis, Carcinogenesis and Teratogenesis. May 26-29, 1991, Caxambu, Brazil.

3. Symposium Speaker, Cytogenetics and Related Genetic Endpoints for Detection of Problems from Exposure to Hazardous Waste Chemicals. World Congress on Cell and Tissue Culture. Anaheim, CA, June 16-20, 1991.

4. Symposium Speaker, Abnormal Chromosome Repair and Risk to Develop Cancer. First International Conference on Environmental Mutagenesis in Human Populations at Risk, January 20-25, 1992, Cairo, Egypt.

5. Symposium Speaker, Identification of Potential Health Risk from Exposure to Occupational and Environmental Agents. Hebrew University, Jerusalem, Israel, January 29-30, 1992.

6. Symposium Speaker, Cytogenetic Approach to Document Factors that Contribute to the Development of Cancer. World Conference on Cell and Tissue Culture. Washington, D.C., June 20-25, 1992.

7. Symposium Speaker, Sensitivity and Application of Cytogenetic Assays for Detecting Biological Effects and for Prediction of Potential Health Risk. IV European ISSX Meeting, Bologna, Italy, July 3-6, 1992.

8. Course Director and Lecturer, Strategies for the Control of Mutagenic and Carcinogenic Risk. Sao Paolo State University. Sao Jose du Rio Preto, Brazil, August 12-22, 1992.

9. Invited symposium speaker on Environmental Mutagenesis and Carcinogenesis. National Biological Sciences Conference in Colombia, Papayan, Colombia, October 2-12, 1992.

10. Seminar Speaker, Cytogenetics and Molecular Biomarkers for Exposure to Toxicants and for Potential Health Risk. U.S. Environmental Protection Agency, Environ-mental Criteria and Assessment Office, Cincinnati, Ohio, March 8, 1993.

11. Seminar speaker and class lecturer, Prediction of potential health risk from exposure to hazardous agents. University of Texas at El Paso, February 24-25, 1994.

12. Symposium speaker, International Symposium on Health Hazards of Glycol Ethers, Nancy, France, April 19-21, 1994.

13. Member, Site Visit Team to Kazakhstan, Russia, to review radioactive contamination problems, July 29-August 9, 1994.

14. Symposium speaker, Induction of Abnormal DNA Repair Response from Exposure to Environmental Toxicants, 2nd Latin American Conference on Environmental Mutagenesis, Puerto Vallarta, Mexico, September 25-30, 1994.

15. Symposium speaker, Repair Deficiency in Cancer Susceptibility, Second InternationalConference on Environmental Mutagens in Human Populations, Prague, Czech Republic, August 20-25, 1995.

16. Keynote speaker, genetic predicposition for development of cancer. Colombian National Scientific Conference, Bogota, October 9-11, 1995; monitoring exposed populations for prediction of health risk. Workshop at University of Cauca, Popayan, Colombia, October 12-17, 1995.

17. Keynote speaker, Approaches in Using Standard and Molecular Biomarkers for Health Risk. Conference for the Pan African Environmental Mutagen Society,Cape Town, South Africa, January 23-25, 1996.

18. Seminar speaker, Genetic factors for predisposition to development of cancer, University of Texas MD Anderson Cancer Center, September 9, 1996.

19. Symposium speaker, Cancer risk assessment based on inheritance of polymorphic genes and exposure to environmental toxicants. Korean Environmental Mutagen Society Conference, Seoul, Korea, October 9-11, 1996.

20. Symposium speaker, IV Conference of the Asociacion Latinoamericana de Mutagenesis, Carcinogenesis y Teratogenesis Ambiental, Vina del Mar, Chile, November 3 - 7, 1996.

21. Symposium speaker, Princess Chulabhorn Conference on Environmental and Industrial Toxicology, Bangkok, Thailand, November 9 - 13, 1996.

22. Invited speaker, Conference on Cancer and Genetic Risk Assessment: Low Dose -Effect Studies. Heidelberg, Germany, September 4-6, 1997.

23. Invited Worshop faculty, 4th Alexander hollaender Training Course in Genetic Toxicology. Cairo, Egypt, September 15 - 18, 1997.

24. Invited speaker to the 5th Latinamerican Environmental Mutagen, Carcinogen and Teratogen Society Conference, Curitiba, Brazil, November 15 - 18, 1998.

25. Invited speaker to the 3rd International Conference on Environmental Mutagens in Human Populations. Bangkok, Thailand, November 28- Decemeber 4, 1998.

26. Invited speaker to the International Conference "Current Status and International Strategy on Endocrine Disrupters", Korean Food and Drug Administration, Seoul, Korea, June 16 - 19, 1999. Presentation title: Genetic Susceptibility and Environmental Disease.

27. Invited by the Minister of Health and the Yang Ming University, Taiwain to Present lectures, Taipei, Taiwan, June 21 - 26, 1999. Lecture title: Use of Biomarkers for Exposure to Genotoxic Agents and for Health Risk Assessment.

28. Invited by the Osaka University Medical School to give lecture in the program "Research for the Future", Osaka, Japan, June 26 - July 1, 1999. Lecture title: A New Technology to Evaluate the Risk of Environmental Toxic Agents to Human.

29. Invited by the National Cancer Center Research Institute to give a lecture entitled "Genetic Variations in Metabolism of Environmental Toxicants and in Development of Environmental Disease", Tokyo, Japan, July 1 - July 3, 1999.

30. Invited by the NATO Advanced Study Institute to be a lecturer in the course entitled "Human Monitoring after Environmental and Occupational Exposure to Chemical and Physical Agents, September 23 - October 3, 1999, Antalya, Turkey.

31. Invited by the Brazilian Association for Environmental Mutagenesis, Carcinogenesis and Teratogenesis for a symposium lecture "Genetic Susceptibility to Environmental Disease", Aquas de Sao Pedro, Brazil, December 5 - 8, 1999.

32. Invited by the Colombian National Congress of Genetics and the Hollaneder course to give a lecture on "Genetic Susceptibility on the Quality of Life", Popayan, Colombia, February 23 - 25, 2000.

33. Invited by the 6th International Symposium on Pharmaceutical Sciences to present a lecture on "Metabolic Susceptibility on Environmental Disease and Response to Medication", Ankara, Turkey, June 27 - 29, 2000.

34. Invited by the 30th Annual Meeting of the European Society for Radiation Biology to give a lecture on "Inherited and Acquired Susceptibility on Environmental Disease", Warszawa, Poland, August 27 - 31, 2000.

35. Invited lecturer, "Life style factors and acquired susceptibility to environmental disease" in the conference on Biomarkers for Genetic and Acquired Susceptibility to Disease, Bremen, Germany, August 31 - September 1, 2000.

36. Keynote Speaker, Hong Kong International Cancer Congress, on "Genetic Susceptibility to Environmental Cancer." Hong Kong, December 6 - 9, 2000.

37. Invited speaker: 8th International Conference on Environmental Mutagens, on "Acquired biological effects from exposure to environmental toxicants." Shizuoka, Japan, October 21 - 26, 2001.

38. Keynote speaker: NATO Advanced Research Workshop on Human Monitoring for Genetic Effects, on "Genetic and Acquired Susceptibility to Environmental Cancer", June 23 - 27, 2002, Krakow, Poland.

39. Seminar speaker: Susceptibility, biomarkers and environmental disease, University of Mainz, Germany, October 5, 2002.

BIBLIOGRAPHY:

A. Peer-Reviewed Articles in Journals

1. **Au, W.W.**, Fechheimer, N.S., and Soukup, S. Identification of the Sex Chromosomes in the Bald Eagle. Canad. J. Genet. Cytogenet. 17: 187-191: 1975.

2. Soukup, S., and **Au, W.W.** The Effect of Ethylnitrosourea on Chromosome Aberrations In Vitro and In Vivo. Humangenetik 29: 319-328: 1975.

3. McAllister, R.M., Isascs, H., Rongey, R., Peer, M., **Au, W.W.** Establishment of a Human Medulloblastoma Cell Line. Int. J. Cancer 20: 206-212: 1977.

4. **Au, W.W.**, Soukup, S., and Mandybur, T.I. Excess Chromosome 4 in Ethylnitrosourea-induced Neurogenic Tumor Lines of the Rat. J. Natl. Cancer Inst. 59: 1709-1716: 1977.

5. **Au, W.W.**, Pathak, S., Collie, S., Hsu, T.C. Cytogenetic Toxicity of Gentian Violet and Crystal Violet on Mammalian Cells In Vitro. Mutation Res. 58: 269-276: 1978.

6. **Au, W.W.**, Butler, M.A., Bloom, S.E., and Matney, T.S. Further Study of the Genetic Toxicity of Gentian Violet. Mutation Res. 66: 103-112: 1979.

7. **Au, W.W.**, and Witek, Jo Ann. Cytochemical Analysis on a Case of Familial 17ps. Human Genetics 48: 195-199: 1979.

8. **Au, W.W.**, and Hsu, T.C. Studies on the Clastogenic Effects of Biological Stains and Dyes. Environ. Mutagenesis 1: 27-35: 1979.

9. **Au, W.W.**, Sokova, O.I., Kopnin, B., and Arrighi, F.E. Cytogenetic Toxicity of Cyclophosphamide and Its Metabolite In Vitro. Cytogenet. and Cell Genet. 26: 108-116: 1980.

10. Ledbetter, D.H., Riccardi, V.M., **Au, W.W.**, Wilson, D.P., and Holmquist, G.P. Ring Chromosome 15, Phenotype, Secondary Aneuploidy, Ag-NOR Analysis and Associated Chromosome Instability. Cytogenet. and Cell Genet. 27: 111-122: 1980.

11. **Au, W.W.**, Johnston, D.A., Collie, C.J., and Hsu, T.C. Short-Term Cytogenetic Assays of Nine Cancer Chemotherapeutic Drugs with Metabolic Activation. Environ. Mutagenesis 2: 455-465: 1980.

12. **Au, W.W.**, and Hsu, T.C. The Genotoxic Effects of Adriamycin in Somatic Cells and Germinal Cells of the Mouse. Mutation Res. 79: 351-361: 1980.

13. **Au, W.W.**, Butler, M.A., Matney, T.S., and Loo, T.L. A Comparative Structure-genotoxic Study of Three Aminoanthraquinone Drugs and Doxorubicin. Cancer Res. 41: 376-379: 1981.

14. Preston, R.J., **Au, W.W.**, Bender, M., Brewen, J.G., Carrano, T., Heddle, J.A.M., McFee, A.F., Wolff, S., and Wassom, J.S. In Vivo and In Vitro Cytogenetic Assays: A Report of the "Gene-Tox" Program. Mutation Res. 87: 143- 188: 1981.

15. Fabricant, J., **Au, W.W.**, Fabricant, R.N., Frost, A.F., and Morgan, K.S. Sister Chromatid Exchanges and Unscheduled DNA Synthesis Studies in a Family with Retinoblastoma. Teratog. Carcinog. Mutagen 2: 85-90: 1982.

16. **Au, W.W.**, Obergoenner, N., Goldenthal, K.L., Corry, P., and Willingham, V. Sister Chromatid Exchanges in Mouse Embryos After Exposure to Ultrasound In Utero. Mutation Res. 103: 315-320: 1982.

17. Li, Shende, **Au, W.W.**, Schmoyer, R.L., and Hsu, T.C. Spontaneous and Mitomycin C-induced Sister Chromatid Exchanges in a Melanoma and a Colon Tumor Cell Line. Cancer Genet. Cytogenet. 6: 243-248: 1982.

18. Meistrich, M.L., Finch, M., daCunha, M.F., Hacker, U., **Au, W.W.** Damaging Effects of Fourteen Chemotherapeutic Drugs on Mouse Testis Cells. Cancer Res. 42: 122-131: 1982.

19. **Au, W.W.**, Luippold, H.E., and Otten, J.A. Development of a transplantable mouse myeloid leukemia model system: a preliminary report. Prog. Nucl. Acid Res. and Mol. Biol. 29, 47-50: 1983.

20. **Au, W.W.**, Callaham, M.F., Workman, M.L., and Huberman, E. Double minute chromatin bodies and other chromosome alterations in human myeloid HL-60 leukemia cells susceptible or resistant to induction of differentiation by phorbol-12-myristate-13-acetate. Cancer Res. 43, 5873-5878: 1983.

21. **Au, W.W.**, O'Neill, J.P., Wang, W., Luippold, H.E., and Preston, R.J. Induction of chromosome aberrations and specific locus mutation but not sister chromatid exchanges in Chinese hamster ovary cells by neocarzinostatin. Teratog. Carcinog. Mutagen 4, 515-522: 1984.

22. **Au, W.W.**, and Goldenthal, K.L. Normal sister chromatid exchange frequencies during growth of a transplantable murine myeloid leukemia. Cancer Genet. Cytogenet. 14, 125- 130: 1985.

23. Schaefer, E., **Au, W.W.**, and Selkirk, J. Differential induction of sister chromatid exchanges by benzo[a]pyrene in variant mouse hepatoma cells. Mutat. Res. 143, 69-74: 1985.

24. Aardema, M.J., **Au, W.W.**, Hand, R.E., and Preston, R.J. Differential sensitivity of a mouse myeloid leukemia cell line and normal bone marrow cells to x-ray-induced chromosome aberrations. Cancer Res. 45:5321-5327: 1985.

25. Rithidech, K., **Au, W.W.**, Sadagopa Ramanujam, V.M., Whorton, E.B., Jr., and Legator, M.S. Induction of chromosome aberration in lymphocytes of mice after subchronic exposure to benzene. Mutat. Res. 188:135-140: 1987.

26. Talaska, G., **Au, W.W.,** Randerath, K., Ward, J.B., Jr. and Legator, M.S. The Correlation between DNA Adducts and Chromosomal Aberrations in the Target Organ of Benzidine Exposed, Partially-hepatectomized Mice. Carcinogenesis, 8:1899-1905: 1987.

27. Shafik, H.M., **Au, W.W.** and Legator, M.S. Chromosomal radiosensitivity of Down syndrome lymphoyctes at different stages of the cell cycle. Hum Genet 78:71-75: 1988.

28. **Au, W.W.,** Ward, J.B., Jr., Sadagopa Ramanujam, V.M., Harper, B.L., Moslen, M.T. and Legator, M.S. Genotoxic effects of a sub-acute low level inhalation exposure to a mixture of carcinogenic chemicals. Mutat Res 203:103-115: 1988.

29. **Au, W.W.**, Bibbins, P., Ward, J.B., Jr. and Legator, M.S. Development of a rodent lung macrophage chromosome aberration assay. Mutat. Res. 208:1-7: 1988.

30. Parkening, T.A., Collins, T.J. and **Au, W.W.** Paternal age and its effects on reproduction in C57B1/6NNia mice. J. Gerontology 43:879-84: 1988.

31. Hagmar, L., Bellander, T., Hogstedt, B., Hallberg, T., Attewell, R., Raihle, G., **Au, W.W.**, Legator, M.S., Mitelman, F. and Skerfving, S. Biological effects in a chemical factory with mutagenic exposure. I. Cytogenetic and haematological parameters. Int. Arch. Occup. Environ. Health 60:437-444: 1988.

32. Rithidech, K., **Au, W.W.**, Sadagopa Ramanujam, V.M., Whorton, E.B., Jr., and Legator, M.S. The persistence of micronuclei in peripheral blood normochromatic erythrocytes of subchronically benzene-treated male mice. Environ Mol. Mutag: 12:319-329: 1988.

33. AbuBakar, S., **Au, W.W.**, Legator, M.S. and Albrecht, T.B. Induction of chromosome aberrations and mitotic arrest by cytomegalovirus in human cells. Environ. Mol. Mutag. 12:409-420: 1988.

34. Anwar, W.A., **Au, W.W.**, Legator, M.S. and Sadagopa Ramanujam, V.M. Effect of dimethyl sulfoxide on the genotoxicity and metabolism of benzene in vivo. Carcinog. 3:441-445: 1989.

35. Anwar, W.A., **Au, W.W.**, Sadagopa Ramanujam, V.M. and Legator, M.S. Enhancement of benzene clastogenicity by praziquantel in mice. Mutat. Res. 222:283-289: 1989.

36. MacLaren, R.A., **Au, W.W.** and Legator, M.S. The effect of 3- aminobenzamide on x-ray induction of chromosome aberrations in Down syndrome lymphocytes. Mutat. Res. 222(1):1-7: 1989.

37. Harper, B.L., Ward, Jr., J.B., Sadagopa Ramanujam, V.M., Ammenheuser, M.A., **Au, W.W.**, Moslen, M.T. and Legator, M.S. A combined testing protocol for assessing genotoxicity in individual animals: application to environmental toxicology. J. Appl. Tox. 9(2):97-102: 1989.

38. **Au, W.W.**, Cantelli-Forti, G., Hrelia, P., and Legator, M.S. Cytogenetic assays in genotoxic studies: Somatic cell effects of benzene and germinal cell effects of dibromochloropropane. Teratog.Carcinog.Mutag. 10:125-134. 1990.

39. Lowery, M.C., **Au, W.W.**, Adams, P.M., Whorton, E.B. Jr. and Legator, M.S. Male-mediated behavioral abnormalities. Mutation Research: 229:213-230,1990.

40. Shafik, H.M., **Au, W.W.**, Whorton, E.B. and Legator, M.S. Distribution of x-ray induced chromosome breakpoints in Down syndrome lymphocytes. Am. J. Med. Genet.: 57:195-200, 1990.

41. **Au, W.W.,** Anwar, W., Paolini, M., Sadagopa Ramanujam, V.M. and Cantelli-Forti, G. Mechanism of Genotoxic and Co-Genotoxic Activity of Cremophore with Benzene in Mice. Carcinogenesis, 12:53-57, 1991.

42. **Au, W.W.**, Walker D.M., Ward, J.B., Whorton E., Legator, M.S., and Singh V. Factors contributing to chromosome damage in lymphocytes of cigarette smokers. Mutation Research, 260:137-144, 1991.

43. **Au, W.W.**, Ramanujam, V.M.S., Ward, Jr., J.B., and Legator, S.M. Chromosome aberrations in lymphocytes of mice after sub-acute low-level inhalation exposure to benzene. Mutation Research, 260:219-224, 1991.

44. Ammenheuser, M.M., Ward, J.B., **Au, W.W.,** Whorton, E.B., Jr., and Belli, J.A. Comparison of Hprt Variant Frequencies and Chromosome Aberration Frequencies in

Lymphocytes from Radiotherapy and Chemotherapy Patients: A Prospective Study. Environ. Mol. Mutag., 18:126-135, 1991.

45. Deng, C.Z., AbuBakar, S., Fons, M.P., Boldogh, I., **Au, W.W.** and Albrecht T. Human Cytomegalovirus-Enhanced Induction of Chromosome Aberrations in Human Peripheral Blood Lymphocytes Treated With Potent Genotoxic Agents. Environ. Mol. Mutag. 19:304-310, 1992.

46. Hoyos, L.S., **Au, W.W.**, Heo, M.Y. and Legator, M.S. Evaluation of the Genotoxic Effects of a Folk Medicine, Petiveria Alliacea. Mutat. Res. 280:29-34, 1992.

47. Legator, M., and **Au, W.W**. Genetic monitoring: the practical approach to population studies. Int. J. Occup. Med. Toxicol. 1: 101-108, 1992.

48. Anwar, W., **Au, W.W.**, Massoud, A., Gentile, J., and Ashby, J. First International Conference on Environmental Mutagens in Human Populations at Risk. Mutat Res. 272:83-88, 1992.

49. Ma, H., An, J., Hsie, A.W., **Au, W.W**. Mutagenicity and cytotoxicity of 2-methoxyethanol and its metabolites in Chinese hamster cells. Mutat. Res. 298:219-225, 1993.

50. Heo, M.Y., Yu, K.S., Kim, K.H., Kim, H.P. and **Au, W.W**. Anticlastogenic Effect of Flavonoids Against Mutagen-Induced Micronuclei in Mice. Mutat. Res. 284:243-249, 1993.

51. **Au, W.**, Morris, D.L. and Legator, M.S. Evaluation of the clastogenic effects of 2-methoxyethanol in mice. Mutat. Res. 300:273-280, 1993.

52. **Au, W.W**. Abnormal chromosome repair and risk to develop cancer. Environ. Health Persp. 101(S3):303-308, 1993.

53. Heo, M.Y., Kwon, C.H., Sohn, D.H., Lee, S.J., Kim, S.W., Kim, J.H. and **Au, W.W**. Effects of flavonol derivatives on the micronuclei formation by n-methyl-n'-nitro-n-nitrosoguanidine and the enhancement of bleomycin-induced chromosome aberration by n-methyl-n'-nitro-n-nitrosoguanidine. Arch. Pharm. Res. 16(3):196-204, 1993.

54. Ashby, J., Anwar, W., **Au, W.W.**, Massoud, A. and Gentile, J. Genetic toxicology in developing countries: comments and recommendations. Environ. Health Persp. 101(S3):335-340, 1993.

55. **Au, W.**, Lakoski, J.M. and Legator, M.S. Evaluation of toxic and genotoxic effects

of bromacil. Part I: Cytogenetic study using bone marrow cells of B6C3F1 mice. J. Occup. Med. Tox. 2:169-171, 1993.

56. Lakoski, J.M., Arentsen, M.I., Kneisley, M.L., **Au, W.W.** and Legator, M.S. Evaluation of toxic and genotoxic effects of bromacil: Part II: Open Field Behavioral Assessment of Locomotor Effects in the Rat. J. Occup. Med. Tox. 2:172-182, 1993.

57. Lee, S.J., Kwon, C.H., Kim, K.H., Sohn, D.H., Heo, M.Y. and **Au, W.W.** Anti-clastogenic effects of galangin against N-methyl-N'-nitro-N-nitrosoguanidine-induced micronuclei in bone-marrow cells of C57BL/6 mice. Journal of Appl. Pharmacol. 2:183-187, 1993.

58. Ahmed, A.E., Jacob, S. and **Au, W.W.** Quantitative whole body autoradiographic disposition of glycol ether in mice: effect of route of administration. Fund. Applied Tox. 22:266-276, 1994.

59. Chiewchanwit, T. and **Au, W.W.** Cytogenetic effects of methoxyacetaldehyde: a metabolite of 2-methoxyethanol in mammalian cells in vitro. Mutat. Res. 320: 125-132, 1994.

60. Hanania, E.G., **Au, W.W.**, Ullrich, R.L. and Papaconstantinou, J. Involvement of the retinoblastoma gene in a mouse mammary tumor model. Cancer Res., Therapy,Control 4:67-76, 1994.

61. **Au, W.W.**, Heo, M.Y. and Chiewchanwit, T. Toxicological evaluation of chemical interactions: nickel on chromosome damage and repair. Environ. Health Persp., 102(Suppl. 9) 73-77, 1994.

62. Legator, M.S. and **Au, W.W.** Application of integrated genetic monitoring: the optimal approach for detecting environmental carcinogens. Env. Health Persp., 102(Suppl. 9) 125-132, 1994.

63. **Au, W.W.**, Anwar, W.W. and Hanania, E.G. Chromosome, oncogene and tumor suppressor gene changes in mouse mammary tumor cells during transformation and after transfection. Cancer Res., Therapy, Control, 4: 109-118, 1994.

64. Heo, M.Y., Lee, S.S., Kwon, C.H., Kim, S.W., Sohn, D.H. and **Au, W.W.** Anticlastogenic effects of galangin against bleomycin-induced chromosome aberrations in mouse spleen lymphocytes. Mutat. Res., 311: 225-229, 1995.

65. **Au, W.W.**, Bechtold, W.E., Whorton, E.B., Jr. and Legator, M.S. Chromosome aberrations and response to gamma-ray challenge in lymphocytes of workers exposed to 1,3-butadiene. Mutat. Res., 334, 125-130, 1995.

66. **Au, W.W.**, Lane, R.G., Legator, M.S., Whorton, E.B., Jr., Wilkinson, G.S. and Gabehart, G.J. Biomarker monitoring of a population residing near uranium mining activities. Environ. Health Persp., 103: 466-470, 1995.

67. Moslen, M.T., Kaphalia, L., Balasubramanian, H., Yin, Y.M. and **Au, W.W.** Species differences in testicular and hepatic biotransformation of 2-methoxyethanol. Toxicology, 96:217-224, 1995.

68. Chiewchanwit, T. and **Au, W.** Mutagenicity and cytotoxicity of 2-butoxyethanol andits metabolite, 2-butoxyacetaldehyde, in Chinese hamster ovary (CHO-AS52) cells. Mutat. Res., 334: 342-346, 1995.

69. Hanania, E.G., **Au, W.W.**, Ullrich, R.L. and Papaconstantinou, J. Regulation of retinoblastoma gene expression in a mouse mammary tumor model. Cancer Gene Therapy, 2:251-262, 1995.

70. Chiewchanwit, T., Ma, H., El-Zein, R., Hallberg, L. and **Au, W.** Induction of deletion mutations by methoxyacetaldehyde in Chinese hamster ovary (AS52) cells. Mutat. Res., 335:121-128, 1995.

71. El Zein, R., Tyring, S., **Au, W.** Chromosomal radiosensitivity of lymphocytes from skin-cancer prone patients. Mutat. Res., 335:143-149, 1995.

72. **Au, W.W.**, Ahmed, A.E., Chiewchanwit, T., Hsie, A.W., Ma, H., Moslen, M.T. Toxicity and genotoxicity of 2-methoxyethanol in vitro and in vivo. In press: Occupational Hygiene, 2, 177-186, 1996.

73. Hoyos, L.S., Carvajal, S., Solano, L., Rodriguez. J., Orozoo, L., Lopez, Y. and **Au, W.W**. Cytogenetic monitoring of farmers exposed to pesticides in Colombia. Environ. Health Persp., 104, (suppl. 3) 535-538, 1996.

74. Hallberg, L.M., El Zein, R., Grossman, L., and **Au, W.W**. Measurement of DNA repair deficiency in workers exposed to benzene. Environ. Health Persp. 104, suppl. 3, 529-534, 1996.

75. **Au, W.W.**, Wilkinson, G.S., Tyring, S.K., Legator, M.S., El Zein, R., Hallberg, L.M., Heo, M.Y. Monitoring populations for DNA repair deficiency and for cancer susceptibility. Environ. Health Persp., 104 (suppl. 3) 579-584, 1996.

76. **Au, W.W.**, Sram, R., Co-Editors: Monograph for the Second International Conference on Environmental Mutagens in Human Populations (51 manuscripts in 1117 type-written pages). Environ. Health Persp. 104 (suppl 3) 421-690, 1996.

77. Heo, M.-Y., Jae, L.H., Jung, S.S. and **Au, W.** Anticlastogenic effect of galangin against mitomycin C-induced micronucleated reticulocytes of mouse peripheral blood. Mutat. Res., 360, 37-41, 1996.

78. **Au, W.W.**, Rodriguez, G., Rocco, C., Legator, M.S., and Wilkinson, G.S. Chromosomal damage and DNA repair response in lymphocytes of women who had children with neural tube defects. Mutat. Res. 361, 17-21, 1996.

79. Anwar, W.A., Abdel-Rahman, S.Z., El-Zein, R.A., Mostafa, H.M., and **Au, W.W.** Genetic polymorphism of GSTM1, CYP2E1 and CYP2D6 in Egyptian bladder cancer patients. Carcinogenesis 17, 1923-1929, 1996.

80. Ratanavalachai, T.C., **Au, W.W.** Effects of reactive oxygen species (ROS) modulators, TEMPOL and catalase, on MALD-induced chromosome aberrations in Chinese hamster ovary (CHO)-AS52 cells. Mutat. Res. 357, 25 - 33, 1996.

81. Abdel-Rahman, S., El-Zein, R.A., Anwar, W.A., **Au, W.W.** A multiplex PCR procedure for geneic polymorphism of the GSTM1 and GSTT1 genes in humans. Cancer Letters 107, 229 - 233, , 1996.

82. El-Zein, R., Zwischenberger, J.B., Abdel-Rahman, S.Z., Sankar, A.B., and **Au, W. W.** Polymorhphism of metabolizing genes and lung cancer histology: prevelance of CYP2E1 in adenocarcinoma. Cancer Letters 112, 71-78, 1997.

83. Hallberg, L.M., Bechtold, W.E., Grady, J., Legator, M.S., **Au, W.W.** Abnormal DNA repair activities in lymphocytes of workers exposed to 1,3-butadiene. Mutat. Res., 383, 213-221, 1997.

84. El-Zein, R., Conforti-Froes, N., and **Au, W.W.** Interactions between genetic predisposition and environmental toxicants for development of lung cancer. Environ. Mol. Mutag. 30, 196-204, 1997.

85. Abdel-Rahman, S.Z., Anwar, W.A., Mostafa, H.M., Abdel-Aal, M.A. Ghoneim, and **Au, W.W.** The CYP2D6 extensive metabolizer genotype increases the risk for bladder cancer. Cancer Let. 119, 115-122, 1997.

86. Conforti-Froes, N., El-Zein, R., Abdel-Rahman, S.Z., Zwischenberger, J.B. and **Au, W.W.** Predisposing genes and increased chromosome aberrations in lung cancer cigarette smokers. Mutat. Res. 379, 53-59, 1997.

87. El-Zein, R., Zwischenberger, J.B., Wood, T.G., Abdel-Rahman, S.Z., Brekelbaum, C., **Au, W.W.** Combined genetic polymorphism and risk for development of lung cancer. Mutat. Res., 381, 189-200, 1997.

88. Abdel-Rahman, S.Z., Anwar, W.A., Mostafa, S., and **Au, W.W.** GSTM1 and GSTT genes are potential risk modifiers for bladder cancer. Cancer Detect. Prevent., 22, 129-138, 1998.

89. McConnell, M.A., Sadagopa Ramanujam, V.M., Alcock, N., **Au, W.W.** Distribution of Uranium-238 and Thorium-232 in environmental samples around uranium mining and milling activities. Environ. Chem. Toxicol., 17: 841-850, 1998.

90. Sohn, S.J., Huh, I.H., **Au, W.W.,** Heo, M.Y. Antigenotoxicity of galangin against N-methyl-N-nitrosourea. Mutat. Res. 402, 231-236, 1998.

91. **Au, W. W.,** Cajas-Salazar, N., and Salama, S. Factors contributing to discrepancies in population monitoring studies. Mutat. Res., 400, 467-478, 1998.

92. Abdel-Rahman, S., El-Zein, R., Zwischenberger, J.B., and **Au, W.W.** Association of the NAT1*10 genotype with increased chromosome aberrations and higher lung cancer risk in cigarette smokers. Mutat. Res., 398, 43-54, 1998.

93. Sierra-Torres, C., Cajas-Salazar, N., Hoyos, L., Zuleta, M., Whorton, E., and **Au, W.W.** In vitro and in vivo gentoxic activity of Miral, an organophosphorus insecticide used in Colombia. Mutat. Res., 415, 59-67, 1998.

94. **Au, W.W.**, McConnell, M.A., Wilkinson, G.S. Ramanujam, Alcock, N. Population monitoring: experience with residents exposed to uranium mining/milling waste. Mutat. Res., 405: 237-245, 1998.

95. Calvert, G.M., Talaska, Mueller, C.A., Ammenheuser, M.M., **Au, W. W.**, Fajen, J.M., Fleming, L.E., Briggle, T., Ward, E. Genotoxicity in workers exposed to methyl bromide. Mutat. Res., 417: 115 - 128, 1998.

96. Heo, M.Y., Kim, J.H., Grady, J.J., **Au, W.W.** Enhancement of chromosome aberrations in lymphocytes of mice after in vivo exposure to clastogens and in vitro challenge with bleomycin. Environ. Mutag. Carcinog., 18: 71-76, 1998.

97. Sohn, S.J., Huh, I.H., **Au, W.w.**, Heo, M.Y. Antigenotoxicity of galangin against N-methyl-N-nitrosourea. Mutat. Res. 402: 231-236, 1998.

98. Salama A.S., Serrana, M., **Au, W.W.** Biomonitoring using accessible human cells for exposure and health risk assessment. Mutat. Res. 436, 99-112, 1999.

98. **Au, W.W.**, Sierra-Torres, H., Cajas-Salazar, N., Shipp, B.K., and Legator, M.S. Cytogenetic effects from exposure to mixed pesticides and the influence from genetic susceptibility. Environ. Health Persp., 107, 501-505, 1999.

99. Oh, H. Y., **Au, W. W.**, Heo, M. Y., Kil, K. S., Chung, W. S. and Huh, G. Opportunity for initiation of an environmental health program in Korea. Environ. Mutag. Carcinog. 19, 1-6, 1999.

100. Salama, A. S., Sierra-Torres, H., Au, W.W. A multiplex PCR, RFLP procedure for simultaneous CYP2E1, mEH and GSTM1 genotyping. Cancer Letters 143, 51-56, 1999.

101. Au, W.W., R., Sierra-Torres, H.C., Cajas-Salazar, N., Salama, A. S. Inheritance of polymorphic metabolizing genes on environmental disease and on quality of life. Mutat. Res., 428, 131-140, 1999.

102. Salama, A.A., Abdel-Rahman, S.Z., Sierra-Torres, C.H., Hamada, F.A., **Au, W. W.** Role of polymorphic GSTM1 and GSTT1 genotypes on NNK-induced genotoxicity. Pharmacogenetics, 9, 735-743, 1999.

103. Abdel-Rahman, S., Salama, A. S., **Au, W.W.,** and Hamada, F.A. The role of polymorphic CYP2E1 and CYP2D6 genes in NNK-induced chromosome aberrations in cultured human lymphocytes. Pharmacogenetics, 10, 239-249, 2000.

104. **Au, W. W.**, Oh, H. Y., Salama, S., and Kietthubthew, S. Genetic susceptibility to enviornmental disease. NATO Science Series, Series A: Life Sciences - Vol. 313, 312 - 318, 2000.

105. Au, W.W., Strategies for conducting human population monitoring studies. NATO Science Series, Series A: Life Sciences - Vol. 313, 86 - 93, 2000.

106. Cebulska-Wailewska, A., Wierzewska, A., Dyga, W., Drag. Z., Siffel, C., Horvath, M., **Au, W.W**. Induction of DNA and cytogenetic damage in lymphocytes of Polish workers exposed to pesticides. Centrol Europ. J. Occup. Environ. Med. 6, 272 - 287, 2000.

107. Salama, S.A., Sierra-Torres, C.H., Oh, H.Y., Hamada, F.A., and **Au, W.W**. Variant metabolizing gene alleles determine the genotoxicity of benzo(a)pyrene. Environ. Mol. Mutag., 37, 17 - 26, 2001.

108. Kietthubthew, S., Hutcha, S., **Au, W.W**. Genetic and environmental interactions on oral cancer in southern Thailand. Environ. Mol. Mutag., 37, 111-116, 2001.

109. **Au, W. W.**, Oh, H.Y., Grady, J., Salama, S., Heo, M.Y. Usefulness of genetic susceptibility and biomarkers for evaluation of environmental health risk. Environ. Mol. Mutag., 37: 215-225, 2001.

110. **Au, W.W.**, Oberheitmann, B., Heo, M.Y., Hoffmann, W., and Oh, H.Y. Biomarker monitoring for health risk based on sensitivity to environmental mutagens. Reviews on Environ. Health 16, 41-64, 2001.

111. Heo, M.Y., Sohn, S.J. **Au, W.W.** Antigenotoxicity of galangin as a cancer chemopreventive agent candidate. Mutat. Res. 488, 135-150, 2001.

112. Moore, T.O., Yen-Moore, A., Carrasco, D., Straten, M.V., Arany, I., **Au, W.W.**, Tyring, S. Human papillomavirus, smoking and cancer. J. Cutan. Med. Surg., 2001.

113. **Au, W.W.** Life style factors and acquired susceptibility to environmental disease. Int. J. Hygiene and Env. Health 204, 17 - 22, 2001.

114. **Au, W. W.**. Susceptibility of children to environmental toxic substances. Int. J. Hyg. Environ. Health, 205, 1-3, 2002.

115. Bonassi, S., **W. W. Au**. Biomarkers in molecular epidemiology studies for health risk prediction. Mutat. Res., 511, 73-86, 2002.

116. **William W. Au**, Henry Falk. Superfund Research Program - accomplishments and future opportunities. Int. J. Hyg. Environ. Health 205, 165-168, 2002.

117. Salama A. Salama, **William W. Au**, Glenn C. Hunter, Richard G. Sheahan, Osama Badary, Ashraf B. Abdel-Naim, Farid M.A. Hamada. Polymorphic xenobiotics-metabolizing genes in susceptibility to atherosclerosis. Environ. Mol. Mutag., 40, 153-160, 2002.

118. **Au, WW**, Oberheitmann, B, Harms, C. Assessing DNA damage and health risk using biomarkers. Mutat. Res., 407, 1-11, 2002.

IN PRESS:

119. Carlos H. Sierra-Torres, **William W. Au**, Concepcion D. Arrastia, Nohelia Cajas-Salazar, Sonia C. Robazetti, Deborah A. Payne, Stephen K. Tyring. Polymorphisms for CYP2E1, GSTM1, and mEH, and the risk for cervical neoplasia. Environ. Mol. Mutagen., 2003.

120. Cajas-Salazar N., **Au, W. W.,** Zwischenberger, JB, Sierra-Torres, HS, Salama, SA, Alpard, SK, Tyring, SK. Effect of expoxide hydrolase polymorphisms on chromosome aberrations and risk for lung cancer. Cancer Genetics Cytogenet., 2003.

SUBMITTED:

121. Salama A. Salama, **William W. Au.** Susceptibility and biomarker knowledge for improvement of environmental health. Int. J. Hyg. Environ. Health, 2003.

122. Sierra-Torres CH., Robazetti CS., Naranjo de Gomez M., Logrono R., Schnadig VJ., Tyring SJ., **Au WW**. Differential Contribution of Risk Factors for Cervical Cancer in the U.S. and Venezuela. Journal of Environ. Comm. Health, 2003

MONOGRAPHS:

1. **Au, W.W.**, Anwar, W.R. and Tennant, R.W. Environmental Mutagenesis in Human Populations at Risk. Environ. Health Persp., 101, Suppl. 3, pp. 1 - 340, 1993.

2. **Au, W. W.**, Sram, R.J. Environmental Mutagens. Environ. Health Persp. 104, Suppl. 3, pp. 421 - 690, 1996.

3. **Au, W. W.**, Chulasiri, M., Kusamran, W., and Waters, M.D. Understanding Gene and Environmental Interactions. Mutat. Res., 428, 1 - 376 (40 manuscripts), 1999.

4. **Au, W. W**. and Legator, M.S. Health hazards from exposure to hydrogen sulfide. Environmental Epidemiology and Toxicology, 9 manuscripts, 1999.

5. Lichtveld, M., **Au, W.W.**, Falk, H. Evaluation of health hazards in communities with exposure to environmental toxicants. Environmental Epidemiology and Toxicology, 23 manuscripts, 2000.

6. Fentzel-Byrn, R., **Au, W.W.** Monograph for the conference on Biomarkers for Genetic and Acquired Susceptibility to Disease. Int. J. Hygiene Env. Health, 204, 1-96, 2002.

7. Spengler RF, Anderson BE, Zenick HH, Au WW, Falk, H. Findings and directions of the US superfund health research program. Intern. J. Hyg. Env. Health 205, 1 - 168, 2002.

BOOK CHAPTERS AND SPECIAL REPORTS

1. Hsu, T.C., and **Au, W.W**. Effects of chemical mutagens on chromosomes. in: Effects of Drugs on the Cell Nucleus. Busch, H., Crooke, S.T., and Daskal, Y., eds., Academic Press, New York, pp. 315-322: 1979.

2. Hsu, T.C., **Au, W.W.**, Strong, L., and Johnston, D. Cytogenetic analysis of chromosome instabilities in human populations. in: Short-Term Test for Chemical Carcinogens. H. Stich, ed., pp. 217-235: 1981.

3. **Au, W.W.**, and Hsu, T.C. In vitro chromosome breakage assays. in: Cytogenetic Assays for Identification of Environmental Mutagens and Carcinogens. T.C. Hsu, ed., Allanheld, Asmum and Co., New Jersey, pp. 203-220: 1982.

4. Heath, C.W., et al. A study of cytogenetic patterns in persons living near the Love Canal. Report submitted to the Center for Disease Control. Atlanta, Georgia: 1983.

5. **Au, W.W.**, and Legator, M.S. Genetic Toxicology - In Utero Exposure to Genotoxic Agents. in: Drug and Chemical Action in Pregnancy (S.E. Fabro, A.R. Scialli eds.) Marcel Dekker, Inc., New York, pp. 335-352: 1986.

6. Legator, M.S., **Au, W.W.**, Harper, B.L., Ramanujam, V.M.S., and Ward, Jr., J.B. Regulatory Implications of a Mobile Animal Monitoring Unit. in: Genetic Toxicology of Environmental Chemicals, Part B: Genetic Effects and Applied Mutagenesis (C. Ramel, B. Lambert and J. Magnusson eds.) Alan R. Liss, Inc., New York, pp. 537-546: 1986.

7. Legator, M.S. and **Au, W.W.** Need to reassess the genetic toxicology of drugs of abuse. Natl. Inst. Drug Abuse Res. Monog. Series, pp 3-2: 1987

8. Albrecht, T., Boldogh, I., Fons, M., Lee, C.H., AbuBakar, S., Russell, J.M. and **Au, W.W.** Cell activation responses to cytomegalovirus (CMV) infection: Relationship to the phasing of CMV replication and to the induction of cellular damage. Subcellular Biochem., 15:157-202: 1989.

9. **Au, William W.** Cytogenetic assays in monitoring human exposure and prediction of risk. In: Monograph of the Second Southeast Asian Workshop on Short-Term Assays for Detecting Environmental Mutagens, Carcinogens and Teratogens: 1989.

10. MacLaren, R.A., **Au, W.W.** and Legator, M.S. 3-aminobenzamide enhances X-ray induction of chromosome aberrations in Down syndrome lymphocytes. In: ADP-Ribose Transfer Reactions: Mechanisms and Biological Significance, eds. M.K. Jacobson and E.L. Jacobson: 1989.

11. **Au, W.W.**, Anwar, W.A., Hanania, E. and Ramanujam, V.M.S. Antimutagenic effects of dimethylsulfoxide on metabolism and genotoxicity of benzene in vivo. In: Antimutagenesis and Anticarcinogenesis Mechanisms II. eds. Y. Kuroda, D.M. Shankel and M.D. Waters: pp. 389-394. 1990

12. **Au, W.W.** Monitoring human population for the effects of radiation and chemical exposures using cytogenetic techniques in: Occupational Medicine: State of the Art Reviews (ed. G. Wilkinson), Hanley and Belfus, Inc., pp. 597-611. 1991.

13. Legator, M.S., **Au, W.W.**, Ammenheuser, M.M. and Ward, J.B., Jr. Elevated Somatic Cell Mutation Frequencies and Altered DNA Repair Responses in Non-smoking Workers Exposed to 1,3-Butadiene, in: Butadiene and Styrene: Assessment of Health Hazards, M. Sorsa, K. Peltonen, H. Vaino, K. Hemminki (eds).

International Agency for Research on Cancer Scientific Publications No. 127, pp. 253-263, 1993.

14. **Au, William W.,** Szucs, S., Sierra-Torres, H. Evaluation of the genotoxic effects of Petiveria alliacea (Anamu) in human lymphocytes. Report of a contract study to the Nature's Sunshine Products Inc., Provo, Utah, 1998.

15. **Au, William W.** Cytogenetic evaluation of Hanford Nuclear Workers. Report of a contract study to Fluor Daniel,/Department of Energy, Richmond, Washington, April 6, 1999.

16. Unnatural Selection: something odd is evolving down on the banana farm. News release on the publication "**Au, W.W.**, Sierra-Torres, H., Cajas-Salazar, N., Shipp, B.K., and Legator, M.S. Cytogenetic effects from exposure to mixed pesticides and the influence from genetic susceptibility. Environ. Health Persp., 107, 501-505, 1999." in New Scientist, pp. 16, June 19, 1999, www.newscientist.com

17. Unterm Druck der Pestizide. News release on the publication "**Au, W.W.**, Sierra-Torres, H., Cajas-Salazar, N., Shipp, B.K., and Legator, M.S. Cytogenetic effects from exposure to mixed pesticides and the influence from genetic susceptibility. Environ. Health Persp., 107, 501-505, 1999." in Geo Wissen, pp. 177 - 178, Nr. 25, 2000; www.geo.de.

18. **Au, W. W.** Sterility caused by pesticides. In Encyclopedia of Pest Management. Ed. D. Pimentel, Marcel Dekker, Inc., New York, NY.

19. **Au, W.W.,** Badary, O., Heo, M.Y. Cytogenetic assays for monitoring populations exposed to environmental mutagens. in: Occupational Medicine: State of the Art Reviews (ed. G. Wilkinson), Vol. 16, #2, pp. 345 - 357, Hanley and Belfus, Inc., 2001.

20. **Au, W. W.**, Anwar, W., Sram, R.J., Chulasiri, M., Ribeiro, L. International conferences on environmental mutagens in human populations - opportunities, accomplishments and challenges. Mutat. Res. Forum, 2002.